THE WRIGHT FLYER PAPERS

Military Payloads Hosted on Commercial Satellites

How Can the Space and Missile Systems Center Increase the Number of Commercially Hosted Military Payload Contract Awards?

Peter A. Cunningham
Major, USAF

Air Command and Staff College
Wright Flyer Paper No. 53

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Foreword

It is my great pleasure to present another issue of *The Wright Flyer Papers*. Through this series, Air Command and Staff College presents a sampling of exemplary research produced by our residence and distance-learning students. This series has long showcased the kind of visionary thinking that drove the aspirations and activities of the earliest aviation pioneers. This year's selection of essays admirably extends that tradition. As the series title indicates, these papers aim to present cutting-edge, actionable knowledge— research that addresses some of the most complex security and defense challenges facing us today.

Recently, *The Wright Flyer Papers* transitioned to an exclusively electronic publication format. It is our hope that our migration from print editions to an electronic-only format will fire even greater intellectual debate among Airmen and fellow members of the profession of arms as the series reaches a growing global audience. By publishing these papers via the Air University Press website, ACSC hopes not only to reach more readers, but also to support Air Force–wide efforts to conserve resources. In this spirit, we invite you to peruse past and current issues of *The Wright Flyer Papers* at http://aupress.maxwell.af.mil/papers_all.asp?cat=wright.

Thank you for supporting *The Wright Flyer Papers* and our efforts to disseminate outstanding ACSC student research for the benefit of our Air Force and war fighters everywhere. We trust that what follows will stimulate thinking, invite debate, and further encourage today's air, space, and cyber war fighters in their continuing search for innovative and improved ways to defend our nation and way of life.

THOMAS H. DEALE
Brigadier General, USAF
Commandant

About the Author

Maj Peter A. Cunningham enlisted in the US Air Force in 1994 and served at Royal Air Force Lakenheath, England, and as a crew chief on F-15 and F-22 aircraft at the Flight Test Center at Edwards AFB, California. He earned his commission in June 2002 after graduating from the Officer Training School at Maxwell AFB, Alabama, and was stationed at Dover AFB, Delaware, where he held positions as an aircraft maintenance officer and maintenance group quality assurance officer on C-5 Galaxy aircraft. Major Cunningham was then assigned to Hanscom AFB, Massachusetts, as a program manager and held a variety of intelligence, surveillance, and reconnaissance (ISR) program management positions. He earned the 2009 Hanscom AFB O'Neill Program Manager of the Year award in the major and below category.

In 2011 Major Cunningham was reassigned to Los Angeles AFB, California, as a program manager in the military satellite communications (MILSATCOM) directorate, where he was charged with standing up the Special Concepts Branch of MILSATCOM's Advanced Concepts Division. He was then selected to lead the space segment of the Advanced Development Division's Rapid Acquisition Branch.

Major Cunningham directly supported a no-notice generation of F-15E strike aircraft for missions over Bosnia-Herzegovina in Operation Deny Flight and served at Incirlik AB, Turkey, in support of Operation Provide Comfort. He led active, Guard, and Reserve personnel at Dover AFB in the initial deployment preparations and ongoing logistical support for Operation Iraqi Freedom. He also led the design, test, and deployment to Afghanistan of the Combatant Commanders Urgent Operational Need Gorgon Stare ISR Exploitation Cell in support of Operation Enduring Freedom.

Major Cunningham has a bachelor of science degree in professional aeronautics from Embry Riddle Aeronautical University and a master of science degree in military operational art and science from Air Command and Staff College. He also holds a level-three certification in program management from the Defense Acquisition University.

Preface

In many instances, what initially appears to be a common-sense solution with synergies to be gleaned by all is often fraught with nuances and complexities which make the implementation of solutions perceived as "common sense" difficult. I have found this to be the case for commercially hosted military payloads (CHMP). That said, the current strong senior leader advocacy for CHMP coupled with the looming budget crisis might yield a perfect storm where the cultural and policy complexities that impede the implementation of CHMPs could be overcome. However, these complexities will not be overcome without a deliberate effort to ensure CHMPs are considered as an option by the acquisition professionals responsible for answering space-based requirements.

I owe many thanks to Joseph Vanderpoorten, the most passionate advocate for doing right by the war fighter and the taxpayer I have encountered in my 18 plus years of service. Mr. Vanderpoorten introduced me to the concept of commercially hosted military payloads and allowed me to present some of my thoughts in his place on a question and answer panel at the American Institute for Aeronautics and Astronautics Conference in Pasadena, California, in September 2012. Mr. Vanderpoorten, thanks for providing me with opportunities to interact with the commercial satellite industry's leading thinkers on CHMPs. I would also like to thank Dr. Fred Stone for his patience and thoughtful guidance during this thesis-writing process.

Finally, to my wife and children, I could not have finished this program without your support and your willing sacrifice of approximately two years of weekends. Thank you for your understanding. I love you.

Abstract

Though Pres. Barack Obama and the Air Force Space Command's (AFSPC) top general officers have advocated for the use of commercially hosted military payloads (CHMP), only one CHMP contract has been awarded by the Air Force. This paper answers the question, how can AFSPC and the Space and Missile Systems Center (SMC) increase the number of CHMP contract awards? Using a problem/solution framework, I examine the acquisition cultural and policy challenges that impede CHMP solutions and choose a solution which could potentially increase the number of CHMP contract awards. I analyze solutions such as awarding an indefinite-delivery/indefinite-quantity hosted payload contract vehicle by SMC, leveraging the Education with Industry program, and issuing an Air Force instruction on CHMPs. The instruction would include an addendum to Directive-Type Memorandum 09-025, Space Systems Acquisition Policy.

Introduction

The Space and Missile Systems Center (SMC), the acquisition arm for Air Force Space Command (AFSPC), is tasked to deliver "resilient and affordable space capabilities."[1] During a 17 January 2012 interview, AFSPC commander Gen William Shelton outlined a fundamental shift in how AFSPC/SMC should accomplish its mission: "We are changing direction. In terms of the overall capability it is much the same . . . but how we achieve that capability is going to be fundamentally different."[2]

One of the "different" approaches General Shelton and SMC would like to leverage is commercially hosted military payloads (CHMP). CHMPs significantly depart from SMC's traditional use of free-flyer solutions to answer payload requirements. A free-flyer procurement approach assumes the purchaser pays for all costs associated with the build, launch, integration, and operations of the satellite and its payload. A CHMP utilizes a commercial satellite's available size, weight, and power (SWaP) to accommodate a military payload. When the military payload requirements and commercial host characteristics match, a CHMP solution can be a cost-saving alternative when compared to a free-flyer solution with the same level of capability.[3] This is due to the satellite and launch costs being apportioned between the commercial host and the military.

The following analogy highlights the differences between CHMPs and free flyers. If an individual at the Los Angeles Airport hires a taxi to transport him or her with luggage (payload) to Anaheim, it would likely cost $150. This is similar to a free-flyer solution. However, if the individual had enough space for an additional person with luggage in the taxi, the cost of the taxi could be shared. A shared taxi is comparable to a CHMP approach.

The Air Force contracted its first and only CHMP in 2008, and the payload was launched on 21 September 2011. The CHMP was a technology development and risk reduction demonstration for a wide field-of-view infrared sensor, known as the commercially hosted infrared payload (CHIRP).[4] The Department of Space Commerce described the CHIRP program as costing $400 million less and being fielded three to 10 years faster than a traditional free-flyer approach.[5] The validity of the cost savings can be debated, as the cost and schedule efficiencies were derived from a direct comparison between the costs of CHIRP and the space-based infrared system (SBIRS) satellite.

CHIRP is an on-orbit demonstration capability. Its overall capabilities are not commensurate with the SBIRS's four mission areas of "missile warning, missile defense, technical intelligence, and battle space aware-

ness."[6] Despite what seems to be an unfair cost savings comparison by the Department of Space Commerce, CHIRP demonstrated that SMC could use a CHMP solution and glean a reduction in both cost and schedule when compared to a free flyer with the same capacity. Given the potential of CHMPs demonstrated through CHIRP, Lt Gen Ellen Pawlikowski, SMC commander and program executive officer for space, would like to continue to make use of available space on commercial satellites to host military payloads.[7]

Significance

With the Budget Control Act reducing discretionary spending by $1 trillion over 10 years, and Department of Defense (DOD) spending lowered by $487 billion, the emphasis to leverage cost-saving measures like CHMPs has received considerable attention.[8] While SMC could glean a potential cost savings when a CHMP is deemed an appropriate solution, CHMPs could also offer a measure of resiliency. The payloads could be hosted on multiple domestic or international commercial satellites, potentially complicating an adversary's plans for attack.[9] Yet despite CHMPs potential to add resiliency while decreasing cost and schedule, not one CHMP contract has been awarded by the Air Force since CHIRP in July of 2008.

Purpose of the Study

This research reviews acquisition complexities that may have contributed to SMC's lack of a CHMP award since its first and only one in 2008. I use a problem/solution framework, analyze the steps SMC has taken to remedy these problems, and recommend additional solutions. It is not in the scope of this paper to discuss the technical or engineering aspects of CHMPs, nor validate or champion the use of CHMPs over other courses of action. This research proposes recommendations which could increase the use of CHMPs should the acquisition community determine a CHMP is the optimum solution. I provide a common understanding of commercial satellite industry partners likely to be in a CHMP arrangement. Next, I review commercial satellite industry business practices and examples of commercially hosted payloads and examine challenges associated with CHMP procurement. Finally, I discuss steps SMC has taken to minimize these challenges and propose additional recommendations, which could result in an increased number of CHMP awards.

Background

It is helpful to understand the characteristics of the commercial satellite industry and CHMPs. This section reviews the key participants likely to be involved in a CHMP contract, provides insight on how the commercial satellite industry manages procurements, and discusses how these practices could benefit SMC. Examples of previous payloads hosted on commercial satellites are also provided.

Commercially Hosted Military Payloads Defined

A 2011 Government Accountability Office (GAO) report on telecommunications in the fixed satellite services industry provides the following definition of hosted payloads: "A hosted payload allows users, such as the government, to add transponders or other equipment to a commercial satellite already scheduled for launch, reducing the time and cost needed to meet demand for satellite capacity . . . assuming resources for hosted payloads can be aligned with satellite manufacturing and launch schedules."[10]

Table 1 provides a quick reference of the four key partners likely to be involved when a CHMP contract is pursued. Each of the partner's roles is also described.

Table 1. Four key partners expected to be involved in a CHMP contract

Role	*Examples*
Commercial satellite owner-operator	Intelsat, ViaSat, Inmarsat, SES, and others
Commercial satellite manufacturer	Space Systems Loral, Orbital, Boeing, and others
Government customer	Space and Missile Systems Center, and others
Military payload manufacturer	Northrop, SAIC, labs, and others

Adapted from Joseph Simonds, George Sullivan, Jie Zhu Jacquot, and Charles Kersten, "Lessons Learned from Hosting an Infrared Payload on a Communications Satellite" (paper presented at the Aerospace Conference, IEEE [Institute of Electrical and Electronics Engineers], Big Sky, Montana, 2010), 1–11.

The commercial satellite owner-operator evaluates whether a business case exists for satellite services in a geographical area. If a case can be made, the owner-operator purchases a satellite and manages the services.[11] Commercial owner-operators, such as Intelsat, Viasat, Inmarsat, or SES, provide services to numerous clients ranging from financial institutions and television networks to the US military. In fact, through satellite leasing arrangements, commercial satellite owner-operators provide nearly 90 percent of the military satellite communications used in Central

Command.[12] The commercial satellite owner-operator is arguably the most important partner in securing a CHMP arrangement. As the satellite's owner, the company must decide if any risk associated with taking on a military payload is worth the financial reward. Commercial satellite owner-operators advocate for CHMPs.[13]

The satellite manufacturer is the company the owner-operator hires to build its satellite. The owner-operator consults the satellite manufacturer to ensure that hosting a military payload is technically feasible. The satellite manufacturer, such as Orbital, Space Systems Loral, or Boeing, is responsible for integration of the military payload along with the owner-operator's primary mission payload on the satellite.

SMC chooses the manufacturer to design the military payload to meet specific government requirements. Laboratories, colleges, federally funded research development centers (FFRDC), and a large variety of contractors, including the satellite manufacturers previously mentioned, can manufacture payloads. Due to the often unique requirements inherent in many military payloads, SMC would likely have the military payload manufactured by an entity other than the manufacturer that built the commercial satellite. This is how the only CHMP contracted by SMC's CHIRP was structured. Science Applications International Corporation (SAIC) built the payload, an advanced infrared wide-field-of-view missile warning sensor; Orbital constructed the satellite; and SES Americom was the owner-operator.[14] However, depending on the military payload requirements, it could be desirable to have the commercial satellite manufacturer build the government payload. The Australian Defence Force (ADF) provided the payload requirements to the commercial owner-operator Intelsat, who awarded the satellite-manufacturing contract to Boeing. Thus, Boeing was responsible for both Intelsat's and the ADF's requirement.[15]

Commercial Satellite Industry Acquisition Culture

Comprehending the commercial satellite industry culture is necessary to better understand the issues addressed on SMC's acquisition culture in the challenges section. I examine insurance costs, the importance of proven components, contract methods, documentation, decisions, and schedules.

Motivation. It is no secret that the commercial satellite industry exists only to make a profit. If operating commercial satellites becomes unprofitable, satellite owner-operators will migrate away from selling communication bandwidth on satellites, forcing the satellite manufacturer to produce a different product. When a commercial satellite owner-operator

determines that it can make a profit by providing satellite communication services over a given region, it desires to have a reliable and capable system on orbit, as fast as possible at the lowest cost to quickly stake its claim in that region and begin earning revenue.

These desires motivate satellite manufacturers to leverage lean manufacturing principles to minimize the "non–value added" processes.[16] These processes make the satellite manufacturer more competitive by reducing the number of unnecessary steps that do not contribute to cost reductions or improved satellite performance. Satellite manufacturers develop efficient tests, supplier management philosophies, and common processes to accelerate the manufacturing cycle, which leads to a faster satellite delivery.[17] Quick delivery and a desire to keep costs low to maximize profit appear to be key motivators of the commercial satellite industry. The next section illustrates how those desires are translated into the commercial satellite industry's unique acquisition culture.

Owner-Operator Insurance Costs and Heritage Components. Satellite insurance rates can have a significant effect on whom the commercial owner-operator chooses to build its satellite and how the satellite manufacturer constructs it. Andrea Maléter, the technical director of the Space and Telecommunications Division of Futron Corporation, a decision-management consulting firm, provided the following analysis regarding the importance of insurance costs for satellite owner-operators and manufacturers. Ms. Maléter determined that insurance policies covering a commercial satellite launch through the first year of in-orbit operations averaged between 17 and 22 percent of the cost of the insured satellite; some markets fetched premiums as high as 30 percent.[18] These insurance costs can run up to $50 million. An additional 12 years of on-orbit operations can result in a combined total of $100 million in insurance premiums.[19] She states that 60 to 70 percent of the insurance cost is based on the choice of satellite, while the launch vehicle and on-orbit operations make up the remainder of the calculation.[20]

The need to keep insurance costs low plays a significant role in the acquisition culture of the commercial satellite industry. To reduce risk of on-orbit malfunctions and subsequently drive down insurance costs, commercial satellite manufacturers attempt to use as many heritage components as the owner-operator's requirements allow.[21] The term *heritage* refers to a component's successful use in orbit on previous satellites. Use of heritage components produces synergistic effects as manufacturers can develop processes which can be reused, reducing the number of contract deliverables an owner-operator would want refusal rights on. This results in increased predictability of expenses with the added benefit of a

reduction in insurance costs. All of these make the satellite manufacturer more competitive in terms of cost and performance.

Contract Deliverables and Design Reviews. The satellite owner-operator reviews the contract deliverable documents to ensure the satellite will meet the demands of the mission and to confirm that the manufacturing process proceeds as planned. Utilization of heritage components decreases the number of contract deliverables required for review. Many complex developmental satellite program contract deliverables can number over 120, with many of these deliverables requiring SMC approval.[22] These deliverables can cause delays, as the owner-operator must wait for customer approval. However, due to the commercial satellite manufacturer's utilization of as many heritage components as possible, the deliverables required for review by the commercial owner-operator are reduced. Typical commercial satellite program deliverables number under 40, with approximately 14 requiring customer approval.[23]

The combination of heritage components and reduced deliverables leads to streamlined design reviews. The commercial satellite manufacturer usually hosts the commercial owner-operator for a preliminary design review (PDR) and a critical design review (CDR). A PDR—the commercial owner-operator's opportunity to review the preliminary satellite design, raise concerns, and discuss needed modifications—is typically held around six months after a contract is signed. After the PDR action items are closed and a way forward is finalized, a CDR is held. The CDR is a "last chance" to review the design before making irrevocable commitments.

Four members (including the author of this paper) of the Military Satellite Communications Directorate (MILSATCOM) attended a commercial satellite PDR as guests of Space Systems Loral (the commercial owner-operator's affiliation cannot be disclosed). Three observations on how the PDR was conducted were noteworthy to the MILSATCOM members in attendance. First was the small number of representatives from the commercial owner-operator. The decision for the commercial owner-operator to have just three representatives and one trainee attend the PDR was curious, given the large investment made. Second, while the commercial satellite manufacturer expertly presented the material, the mastery the commercial owner-operator representatives had of the material was impressive. Finally, the meetings progressed quickly, and few concerns were aired. The event was completed in less than a day and a half. The commercial PDR contrasted starkly to previous government PDRs attended by the MILSATCOM members present. It is not unheard of for 20 or more members of the government to attend a PDR. Government

PDRs often last an entire week and are filled with questions about the contractor's design and recommendations for significant alterations.

After the PDR, MILSATCOM members questioned representatives from both the commercial satellite manufacturer and commercial owner-operator on how the PDR could be completed so efficiently. The commercial owner-operator explained how his or her requirements are stable and the majority of the potentially contentious design issues are typically resolved prior to contract award.[24] This makes the PDR a true review, rather than a design concept which must be vetted. The commercial satellite manufacturer credited the importance of a close relationship with the commercial owner-operator. One of the commercial owner-operator's engineers worked at the Space Systems Loral factory and enjoyed complete access to monitor any phase of the satellite's production. Stable requirements at contract award and a close relationship between the commercial owner-operator and satellite manufacturer allow not only a predictable design review, but also a less complex brand of contract to take place.

Firm Fixed Price. The Defense Contract Management Agency states that a firm-fixed-price contract is used when "a fair and reasonable price can be established at the outset."[25] This means that a product remains at the negotiated costs regardless of the final cost to the manufacturer as long as the requirements are not altered from the original agreement. The familiarity with the product described in the previous sections allows commercial satellite manufacturers to build satellites for commercial owner-operators on firm-fixed-price contracts.

Individuals unfamiliar with acquisition may assume a firm-fixed-price contract is the only logical option to conduct business. However, for many highly developmental efforts or with unstable requirements, cost-plus contracts are standard. Cost-plus contracts "are used when there are enough uncertainties involved in contract performance to preclude using a fixed price contract."[26] Requirements that involve significant development or are unstable can result in unpredictable costs and schedules. Neither of these uncertainties is compatible with the commercial satellite industry's motivation for quick delivery of the satellite and low costs. A firm-fixed-price contract can help commercial owner-operators determine if the purchase of a satellite to operate in a given location would provide an adequate return on investment.

Fast Schedules, Quick Decisions. Commercial satellite production schedules can vary depending on the size and capabilities of the satellite. Typically, commercial satellite manufacturers complete the entire process (from contract award to launch) in just 24 to 32 months.[27] These timelines are achieved in large part because the commercial owner-operator's

requirements are firm when the contract is awarded to the satellite manufacturer. Tim Deaver, a noted expert on CHMPs and SES Americom's program manager on SMC's CHIRP, provided an additional rationale for the ability to achieve that timeline. He explained how commercial industry empowers its program managers to make timely decisions. The program managers are the decision authority for most issues; issues discussed during PDRs and CDRs are closed out at those events.[28] If additional information is required to make an informed decision, those cases are typically closed within a week.[29]

The empowerment of the commercial owner-operator's program managers and embedding his or her engineers at the satellite manufacturer's facility demonstrate the premium placed on schedule. The commercial satellite industry's culture of empowered program managers is a critical component of the acquisition culture, which allows for a firm-fixed-price contract environment as delays for routine decisions increase cost.

Evaluation

Since SMC has awarded only one CHMP, it could be reasoned that few other organizations have leveraged commercial hosting of payloads. Perhaps hosting a payload on commercial satellites is too technically complex or there are not enough opportunities. Yet table 2 illustrates that numerous commercially hosted payload solutions have been implemented by a wide range of entities, foreign and domestic, private and government, from the National Aeronautics and Space Administration (NASA) to the ADF. There also appear to be many opportunities to find suitable commercial hosts for military payloads. General Pawlikowski stated that there are approximately 80 commercial satellites forecasted for launch over the next five years. "You've got a lot of satellites up there and I sure would like to hitch a ride," she said.[30]

Table 2. Examples of commercially hosted payloads

Hosted Payload Name	Payload Capability	Owner-Operator Satellite	Launched
SXI Solar X-ray	Imager for NASA	GEOS L & M	2000/01
UHF, X, Ka Comm	UHF, X, Ka-band Comm for Australian Defence Forces	Optus-C1	2003
Nav/Aviation Comm	Japan Global Positioning System (GPS) augmentation and air traffic control communications	MTSAT-1/1R	2005
JAMI	Japan meteorological imager (visible & infrared)	MTSAT-1/1R	2005
X-band Comm	NATO configured X-band for Spain	XTAR-EUR	2005
IRMA	In-orbit reconfigurable multibeam antenna, X-band	Spainsat	2006
WAAS	Wide area augmentation system, Federal Aviation Administration (FAA) augmentation to GPS for air safety	Galaxy 15, Anik F1R, & Inmarsat 4F3	2007 x2 /09
CCD Camera	Charge coupled device (CCD) visual cameras	Echostar-XI & ICO-G1	2008 x2
NAIS[a]	US Coast Guard national automatic identification system	Orbcomm	2008
IRIS	Cisco Internet router in space	Intelsat-14	2009
Ka-Band Comm	Canadian Ka-band hosted payload	ViaSat-1	2011
CHIRP[b]	USAF infrared missile warning payload	SES-2	2011
ADF UHF[c]	Australian Defence Force UHF payload	Intelsat-22	2012
X-Band Comm	Commercial X-band payload Canadian military	Anik-G1	2012
EGNOS	European GPS navigation overlay system	SES Sirius-5	2012
LCRD[d]	NASA laser comm relay demonstration	To Be Determined	~2016

Adapted from Space Systems Loral, "Hosted & Dispensed Payloads Fact Sheet" (Palo Alto, CA: Space Systems Loral, December 2013), ssloral.com/downloads/payload/hosted_payload_fact_sheet.pdf.

[a]"Emerging Threats Ship-Tracking Satellite Launched," *UPI.com*, 21 June 2008, accessed 29 January 2013, http://www.upi.com/Emerging_Threats/2008/06/21/Ship-tracking-satellite-launched/UPI-17501214032415/.

[b]Robert S. Dudney, "Game Changers in Space," *Air Force Magazine* 95, no. 10 (October 2012): 49–53, accessed 29 January 2013, http://www.airforce-magazine.com/MagazineArchive/Pages/2012/October%202012/1012space.aspx.

[c]"IS-22 in the News," Intelsat, 12 April 2012, accessed 29 January 2013, http://www.intelsat.com/network/satellite/intelsat22/index.asp.

[d]National Aeronautics and Space Administration, "LCRD," Goddard Flight Research Center, accessed 30 January 2013, http://esc.gsfc.nasa.gov/267/LCRD.html.

If evenly distributed, 80 satellites over five years equates to 16 potential CHMP opportunities a year. How can SMC take advantage of these CHMP opportunities? Before this question can be answered, the challenges which have impeded SMC from increasing the number of CHMP contract awards must be understood. First the difficulties in aligning military payload requirements with a commercial host will be examined.

Challenge: Commercial Satellite and Military Payload Alignment

Dr. Jared Fortune, an Aerospace Corporation cost analyst and a University of Southern California systems engineering professor, spent a year studying CHMPs for MILSATCOM. Dr. Fortune interacted with three different commercial satellite manufacturers and four commercial satellite owner-operators. These interactions provided an understanding of the numerous requirements which must align for a commercial satellite to host a military payload. He explained a variety of factors which must be considered before a commercial satellite can be deemed an appropriate fit for a CHMP. First, the commercial satellite orbit must match the specific needs for the government payload requirement. The government payload may require a geosynchronous Earth orbit (GEO), low Earth orbit (LEO), medium Earth orbit (MEO), or another type of orbit. These orbit requirements differ between the needs of the various military payloads. An *Air Force Magazine* article details how the Air Force's 11 satellite programs reside in multiple orbits: six are in GEO, one—the GPS—is in MEO, and four reside in LEO.[31] The commercial owner-operator's satellite orbit is dependent on its mission as well.

Beyond the type of orbit, the government requirements for a specific orbital slot must also align with the commercial satellite. Orbital slot determination dictates where the payload will have coverage. Some military payloads may be open to a wider range of potential orbital slots. However, more often than not a military payload must be within a specific orbital range to accomplish the mission.[32] If the orbital slot required by the military does not align with the commercial owner-operator's needs for its primary mission, this eliminates a potential commercial candidate. The SWaP needs of the military payload must be equal to or less than the SWaP available on the commercial host.[33] If the military payload is too large, draws too much power, or displaces too much heat, potential hosts are eliminated. Finally, if all the previously mentioned items align, a commercial owner-operator must be willing to endure the military as a business partner. If the owner-operator believes hosting a military payload could undermine current or future revenue bearing potential, it could decline hosting the military payload.

These and other factors, such as information assurance/security concerns, led Dr. Fortune to postulate that only 15 percent of the scheduled commercial satellite launches would likely align with an SMC requirement.[34] If the approximately 80 projected commercial launches were spread evenly over the next five years and Dr. Fortune's 15 percent matching factor was applied, this equates to approximately 2.5 feasible CHMP opportunities a year for SMC. These opportunities have a high probability of matching the needs of a military payload; SMC could take advantage of these prospects. However, when one understands the challenges involved with military payload and commercial host alignment, the fact that SMC has awarded only one CHMP contract becomes more understandable.

Challenge: SMC as a Business Partner

With its current annual budget at approximately $10 billion, SMC would be an attractive partner to the commercial satellite industry.[35] Despite the allure of SMC's large budget and industry's desire to generate as much revenue as possible from the available space on its satellites, the decision to host a military payload must be weighed carefully against the potential ramifications. The possible bureaucratic ramifications were evident in a 26 September 2012 memorandum, "Guidance for Obtaining Military SATCOM Services from a Commercial Provider via Hosted Payloads Using Military Spectrum," sent from Maj Gen Robert Wheeler, USAF deputy chief information officer for C4 and information infrastructure capabilities.[36] The memorandum attempted to ensure that a CHMP investment by the government would be protected from potential future business transactions made by a commercial owner-operator. These transactions could relocate a host satellite and potentially render the CHMP useless. The language in the memorandum calls for the government to exercise considerable control over the commercial satellite, with recommendations for right of first refusal clauses to be inserted into the terms and conditions of a CHMP contract.

The clauses recommended in the memorandum seem like smart business from a government perspective, but the commercial satellite industry viewed the guidance as restrictive and lacking its perspective.[37] The memorandum illustrates what the commercial industry must be cautious of before entering into an agreement with the government. The decision to relinquish control over future business opportunities may not come easy for the commercial owner-operator, even if it means an increase in near-term revenues.

The relocation of a commercial satellite to a market with increased demands could yield a significant return on investment for the commercial owner-operator. The near-term revenues gained from the hosted military payload could be less lucrative than the future profit which could be gained through the relocation of the commercial satellite. Therefore the owner-operator must carefully consider the degree of control he or she grants the government over the satellite in any CHMP agreement. Likewise, the government should carefully consider the degree of control it requires and how much it is willing to pay for it. The risks of the owner-operator relocating the satellite must be carefully weighed against the need to operate the CHMP. Dictating blanket contracting language for all CHMPs may provide comfort to senior government officials, but it represents another considerable challenge for award of CHMPs and could increase the cost.

Challenge: SMC Acquisition Culture

Thomas Taverney's article, which reviewed the complexities of a traditional SMC satellite acquisition program, highlights a process that has become an acquisition culture at SMC and likely impedes the number of CHMP contracts awarded.[38] Taverney, a former AFSPC vice commander, explained the vicious circle of space acquisition; over the years the Air Force attempted to minimize the number of satellites it purchased, and in doing so forced numerous requirements to be piled onto single systems.[39] The complexity of these systems drove up costs, resulted in unstable requirements, protracted schedules, and reduced the number of systems that could be purchased.[40]

When the number of systems produced goes down, the risk tolerance for failure becomes very low. Low risk tolerance drives a culture of intense oversight and increases the number of contract deliverables and internal Air Force reviews, which in turn drives an increase in both cost and schedule. A May 2011 GAO report on space acquisition seems to back this perspective. "Over the past two decades, DOD has had difficulties with nearly every space acquisition program, with years of cost and schedule growth, technical and design problems, and oversight and management weaknesses," the report noted.[41]

SMC has contracted complex efforts like the advanced extremely high frequency system, the space-based infrared system, and the subsequently canceled transformational satellite system. During this time, SMC has become accustomed to the processes Taverney described. Herein lies perhaps the most insidious challenge for SMC to overcome when award-

ing CHMPs—the ability to forego its tendency to design complex solutions with numerous formal oversight requirements and adopt simplified solutions that leverage the commercial satellite industry efficiencies of fixed price and fast schedules.

Challenge: Requirements Stability

For many efforts SMC uses a spiral development strategy where the final requirements are not known at the start of the program but are refined through experimentation.[42] This is opposite from the commercial acquisition approach. As mentioned in the section on commercial satellite industry culture, when a commercial owner-operator enters into an agreement with a commercial satellite manufacturer, the requirements are well understood at the award of the contract. Stable requirements allow commercial manufacturers to provide an accurate estimate for the cost and schedule of the satellite build, which permits a firm-fixed-price contract.

According to the aforementioned GAO report, cost predictability and timeliness are two characteristics Air Force satellite programs have not been able to harness.[43] Taverney's article on the Air Force space acquisition system revealed that requirements instability is one of the key problems in space acquisition.[44] Once again, Taverney's concern over unstable requirements is backed by an earlier June 2003 GAO report.[45] The report states DOD satellite programs take longer to develop and cost more "because performance requirements were not adequately defined at the beginning of the program or were changed significantly once the program had already begun."[46]

In a CHMP scenario, unstable requirements equate to delays in the military payload's readiness to be hosted or necessitate alterations to the owner-operator's satellite configuration to accommodate the military payload, causing the government to incur large fines for altering a fixed price contract. A CHIRP lessons-learned essay submitted by SMC CHIRP contracting officers described how a change in the launch date or alterations to the owner-operator's space vehicle resulted in fines being incurred by SMC and could have resulted in termination of the agreement to host CHIRP.[47] Given the history of requirement instability issues spelled out by the GAO and the premium the commercial satellite industry places on schedule, SMC must be able to lock down its payload requirements if it seeks to leverage a CHMP solution.

Challenge: Government Program Managers Not Empowered to Make Timely Decisions

In the section on the commercial satellite industry acquisition culture, I discussed the importance of schedule and how commercial program managers are empowered to make timely decisions. Unfortunately, the opposite is often the case for the government. While the program management mantra of cost, schedule, and performance is often recited, schedule often takes a back seat to the risk-averse culture of not being qualified or empowered to make a decision. It is common to see months of a schedule wasted while decisions get pushed up the chain of command for review. A well-informed program manager would have made these decisions on the spot in the commercial sector.

Deaver, who served as an Air Force lieutenant colonel prior to working for SES Americom, explained that Air Force program managers are trained and experienced acquisition personnel, but not empowered, trained, and experienced engineers. Therefore, the program managers rely upon technical expertise from FFRDC personnel, which comes with its own reporting structure.[48] The differing cultural mind-sets were explained with an experience he had as the SES Americom program manager for SMC's CHIRP program. A ground current loss was discovered during a thermal vacuum test, which would significantly impact cost and schedule if delayed, but on-site engineers assessed that the issue could be corrected after the test with little to no risk.[49] However, the Air Force program manager was not authorized to make the decision to proceed. The program manager's FFRDC technical representative had concerns and raised those concerns through the chain of command. The division chief decided that the executive director of SMC (a two-star general officer equivalent) was required to make the decision, but would not be available for the next few days.[50]

The Air Force program manager likely did what he or she thought was best for the Air Force. However, the choice to wait and run the decision higher up the chain points out SMC's cost plus contracting and low risk mind-set. In a cost plus situation, the contractor can simply delay the test and bill the government while it waits for a decision; the contractor cannot remain idle while the government makes up its mind in a firm-fixed-price commercial satellite environment.

Challenge: Spectrum Certifications Tied to Financing

A certification confirming the availability of needed radio frequencies (referred to as spectrum) to operate in the CHMP's intended orbital location must be received prior to receiving CHMP funding. The White

House Office of Management and Budget (OMB) listed the following requirement: "You must obtain a certification by the National Telecommunications and Information Administration (NTIA) of the Department of Commerce, or your agency as designated by NTIA, that the radio frequencies required can be made available before you submit estimates for the development or procurement of major radio spectrum-dependent communication-electronics systems (*including all systems employing space satellite techniques*)" (emphasis added).[51]

Spectrum allocation certification or the authority to use a specific radio frequency in a given orbital location is essential to ensure funds are not allocated toward a system that may never be permitted to operate. The OMB regulation represents a challenge for CHMPs due to the length of time required to receive the necessary certification before program planning and budgeting can occur. Dr. Albert Merrill, a frequency spectrum subject matter expert for Aerospace's Communication Architectures Department, described how the certification effort requires international coordination and is a "first come, first serve" process which takes between two to seven years for approval.[52]

How does this requirement impact a CHMP solution? SMC must have NTIA certify the availability of spectrum prior to submitting an estimate or receiving funding to build a payload. However, to apply for spectrum certification SMC must know the orbital location of the CHMP, which cannot be determined without knowing who will be the commercial host. SMC must have funding to release a proposal request and conduct a full and open competition to select a host before determining a commercial host.

The length of time it takes to accomplish the spectrum certification is also incongruent with the commercial timeline of contract award to in-orbit operations in just 24 to 32 months. By the time the two- to seven-year spectrum certification process was complete, the commercial host originally targeted would be finished with satellite testing (too late to integrate the military payload on the commercial satellite) or already in orbit.

Challenge: The Military Industrial Complex

The previously mentioned challenges can make CHMPs difficult to implement, but Dr. Daniel Kwon of the commercial satellite manufacturer Orbital Sciences added another concern. Although he did not personally label this as the "military industrial complex" challenge, Dr. Kwon explained that he felt some members of the SBIRS program office were nervous about CHIRP launching and getting data prior to the SBIRS sat-

ellite.[53] The ability to be on orbit in three years instead of nine, and at hundreds of millions of dollars below the cost of a SBIRS satellite, could rob billions from everyone in the program office and the contractors.[54] The hypothesis that implementation of less-complex CHMP solutions, with perceived smaller budgets, would require many influential parties to advocate against their self-interests is not a farfetched notion.

Air Force program managers, government support contractors, and FFRDC—such as the Aerospace Corporation and MITRE—all play a pivotal role in the evaluation and selection of technologies and contracts to be awarded. These personnel, typically members of source selection teams, provide a technical analysis of proposals for the source selection authority to base a contract award decision. While it is true that all members on a source selection, including government personnel, must validate their impartiality from the companies whose proposals are being evaluated, this does not mean they do not have a stake in the outcome.

A government support contractor or FFRDC member's very employment hinges on the size and complexity of the program to be awarded. A unique and complex program with numerous formal oversight mechanisms necessitates an increased number of supporting FFRDC and government contractor personnel. The perception, from a government program manager's viewpoint, is that those who lead programs with large budgets have an increased chance at winning annual awards and therefore would be promoted ahead of peers. Defense contractors like Raytheon, Northrop, Lockheed, and Boeing employ hundreds of thousands of Americans.[55] The companies require a hefty influx of dollars to keep these Americans employed while remaining profitable; large complex developmental efforts keep those dollars flowing in. Elected officials who have significant influence over what programs are funded or remain funded in the defense budget support these companies. Moreover, many influential former general officers are paid considerable sums to wield their influence and advocate for defense contractors while still collecting a paycheck as an advisor to the DOD. "Of the 158 retired generals and admirals identified as having worked for the military as senior mentors, 80 percent had financial ties to defense contractors, including 29 who were full-time executives of defense companies," *USA Today* reported.[56]

Programs like the SBIRS, with its protracted schedules and multibillion dollar overruns, provide a good example of a complex SMC program. The SBIRS cost per satellite climbed to nearly $3 billion, a 230 percent increase over initial estimates. The first satellite was launched approximately nine years late.[57] Pres. Dwight D. Eisenhower foretold of these challenges in his oft-quoted farewell address on 17 January 1961. He is credited as being the first to warn of guarding against unwarranted influ-

ence by the military-industrial complex.[58] Some may scoff at placing blame on a ubiquitous problem such as the military-industrial complex for the lack of CHMP awards, but it cannot be ignored. Ways to deal with this challenge should be considered.

Summary of Challenges

While the aforementioned challenges are far from an exhaustive list of issues that impedes additional CHMP solutions from contract award, one can begin to appreciate the challenge facing SMC's acquisition workforce. This section reviewed the challenges of a military payload requirement aligned with a commercial host and owner-operators' risk tolerance and willingness to deal with the government. It also reviewed how spectrum management policy tied to funding could disrupt CHMP decisions and how the acquisition culture at SMC breeds low-risk tolerance and unempowered program managers. Finally, the potential impact of the military industrial complex was highlighted.

Methodology

A problem/solution framework analyzed the challenges that may have contributed to the lack of CHMP contract awards. I analyzed remedies to the challenges, provided additional recommendations, and examined solutions against set criteria. The first criterion is that solutions should allow SMC program managers to leverage the methods commercial industry may propose to meet the specific requirements for a given military payload. This is critical, as each CHMP opportunity presents a unique set of circumstances that the commercial partners and the Air Force program manager will consider. An attempt to dictate a standard set of rules that apply to all CHMP arrangements limits the commercial satellite industry's ability to construct a deal which could be mutually beneficial to all parties. The restrictive language discussed in General Wheeler's memorandum provided a good example of how an attempt to regulate CHMP arrangements could have a negative effect on commercial partners. The second criterion was that proposed solutions should assist with the satellite acquisition cultural shift. This must take place for SMC and AFSPC requirements community members to consider a CHMP solution as an option for meeting a requirement.

Analysis of Solutions

Eisenhower warned of the military-industrial complex, but in the same speech, he also stated that "it is the task of statesmanship to mold,

to balance, and to integrate these and other forces, new and old, within the principles of our democratic system."[59] Molding, balancing, and instituting change in government bureaucracies can be challenging. However, there is no shortage of senior leader CHMP champions up for the challenge. These leaders have pushed their workforce to find ways to implement CHMP solutions. It starts from the top; Pres. Barack Obama stated in the National Space Policy that the government should explore hosting payloads on commercial space spacecraft (satellites).[60] Former secretary of defense Robert Gates and James R. Clapper, director of national intelligence, outlined commercial hosting of military payloads as a potential cost-effective method of adding resilience to DOD space architectures in the National Security Space Strategy.[61] The responsibility to structure programs which implement the guidance in the National Space Policy and National Security Space Strategy falls to General Pawlikowski at SMC. She took action in the summer of 2011 and allocated workers to retain the knowledge gained from the Air Force's only CHMP acquisition, CHIRP, and tasked those members to establish a Hosted Payload Office at Los Angeles AFB, California. Since then the Hosted Payload Office has pursued solutions that could increase the number of future CHMP awards.

CHMP Solutions in Work at SMC

The first solution to be examined was an effort the SMC Hosted Payload Office, led by Lt Col Mark Brykowytch, was pursuing at the time this paper was written was the award of an Indefinite Delivery Indefinite Quantity (ID/IQ) contract for CHMPs, referred to as the HoPs (Hosted Payloads) ID/IQ. The Federal Acquisition Regulation describes an ID/IQ as an indefinite quantity, "within stated limits, of supplies or services during a fixed period."[62] An ID/IQ prequalifies a group of contractors for exclusive access to bid on efforts that are within the scope of a specific ID/IQ contract, in this case HoPs.

Colonel Brykowytch said that one of the HoPs ID/IQ goals is to maximize the number of contractor awardees.[63] Contractors (owner-operators, satellite manufactures, or payload providers) who could reasonably demonstrate the ability to successfully execute a CHMP contract should be included as an eligible contractor to bid for work under the HoPs ID/IQ. Maximizing the number of awardees increases the odds of overcoming the requirement alignment challenges between the military payload and commercial host. The contractor's manufacturing practices should also be examined to ensure suitability to the government prior to being qualified under the HoPs ID/IQ.

Key processes would be highlighted in the contract; if changed a HoPs ID/IQ contractor would be required to notify the government.[64] This allows for a program office that uses the HoPs ID/IQ to choose the lowest price technically acceptable, as the contractor's processes have already been validated by SMC through the original HoPs ID/IQ award. When a HoPs ID/IQ contractor bids to host a military payload, it is a firm-fixed-priced contract, and Brykowytch explained that "the responsibility is on the contractor to make the ride happen, and determine how to get the data to the end user."[65] This structure allows the commercial owner-operator to select the most efficient solution to meet the CHMP requirements, while the HoPs ID/IQ contract holds it responsible for the decisions made.

The firm-fixed-price contract minimizes the danger of the government introducing requirement perturbations due to the risk of fines being incurred. The onus is on the commercial host to determine how to answer the military payload requirements within the approved processes dictated by the HoPs ID/IQ. Letting the commercial host determine how to meet the requirements also means that the host won't be affected by a government program manager's inability to make timely decisions. Obtaining the frequency spectrum certification could also be a requirement the commercial host must answer. However, one must question what happens if no commercial host bids to accommodate the military payload. Will OMB allow a military payload to be funded based on the assumption a commercial host will obtain a frequency spectrum certification for the payload? More research needs to be done in this area.

The effort to establish the HoPs ID/IQ is evidence that SMC has made a concerted effort to increase the number of CHMP awards in the future. The HoPs ID/IQ aligns with this paper's first criterion to leverage the methods the commercial satellite industry may propose to meet a CHMP's requirements. However, before a program office can fulfill a requirement with a CHMP and leverage the HoPs ID/IQ, a CHMP must be considered as a potential solution. Failing to address the SMC acquisition culture, which has largely opted for unique free-flyer solutions for the last two decades, could result in an innovative HoPs ID/IQ never awarding a single Air Force CHMP.

Actively Leverage Education with Industry Program

AFSPC and SMC could also actively target the Education with Industry (EWI) program to instruct its acquisition workforce on the commercial satellite industry. EWI exposes officers and civil servants to private sectors of the economy, enabling them to understand the management methods, structure, and technologies of modern industry.[66] The Air

Force Institute of Technology (AFIT) manages the EWI program, established in 1947 and sponsored by the secretary of the Air Force for Acquisition.[67] AFSPC and SMC should work closely with AFIT and the commercial satellite industry's owner-operators and manufacturers to have its brightest captains, majors, and civil servants in the space acquisition or requirements disciplines hosted at a commercial satellite industry owner-operator headquarters or a commercial satellite manufacturer's production facility. EWI personnel should be detailed to follow a commercial satellite acquisition for 10 months. AFSPC/SMC, working with the Air Force Personnel Center, should ensure individuals who served an EWI tour within the commercial satellite industry are placed into a program office or requirements position at SMC or AFSPC for a minimum of four years.

This proposed solution could yield long-term benefits if actively managed by AFSPC/SMC leadership. Having witnessed the effectiveness of the commercial satellite industry's acquisition culture firsthand, these EWI tour graduates could encourage the larger SMC/AFSPC workforce to seek out commercial methods where practical. While this solution will not result in an increase in CHMP contract awards in the near term, it would expose AFSPC/SMC acquisition professionals to an alternative way of thinking about satellite acquisition.

Although the EWI solution has merit, it would take a minimum of 20 months to begin to see an impact if the program were implemented tomorrow. Personnel would have to be selected, conduct their 10-month tour, and then be reassigned. The EWI concept does not do enough to increase the number of CHMPs awarded and leaves much to chance. The HoPs ID/IQ, on the other hand, offers a sanctioned contract mechanism to procure CHMP solutions in the near term. For those aware of leadership's sanctioning of the HoPs ID/IQ contract and therefore CHMPs, the HoPs ID/IQ will begin the normalization of SMC leveraging commercial practices through CHMP solutions. Awarding the HoPs ID/IQ contract will not automatically result in CHMPs being considered as solutions. Further action is required to break through the culture of complex free-flyer solutions and the potential ill effects of the military-industrial complex to ensure AFSPC and SMC personnel consider CHMPs as an option.

Air Force Instruction for Commercially Hosted Military Payloads

SMC programs have been developed from a methodology which is dissimilar to the commercial satellite industry's methods. Members of the AFSPC/SMC acquisition and requirements community may have many preconceived notions regarding CHMP solutions and may ques-

tion their authority to leverage commercial satellite industry practices. Some of these acquisition professionals may lack exposure to CHMPs and may not understand how to navigate the many challenges associated with the selection of a CHMP solution. While the HoPs ID/IQ addresses some of these challenges, it assumes that a decision to seek a CHMP solution has already been made. If preconceived notions regarding SMC's ability to leverage CHMPs are not addressed, SMC could end up with an innovative contract vehicle to leverage CHMPs, but no military payloads to host.

The commercial satellite industry and the Defense Acquisition University members recognized the hesitance of the defense space acquisition community to leverage the commercial satellite industry. They collaborated on an article for the *Defense AT&L* magazine which did not specifically address CHMPs but addressed perceived concerns the defense industry may have with leveraging the commercial satellite industry.[68] The article highlighted how part 12 of the Federal Acquisition Regulation requires the government to first seek out commercial nondevelopmental items to meet requirements.[69] These types of articles are helpful in raising awareness about the possibilities of leveraging the commercial satellite industry. However, government leaders have already decided that AFSPC/SMC should leverage CHMPs when it makes sense to do so. Yet despite the leaders' advocacy, only one CHMP contract has been awarded by the Air Force.

Writing an Air Force instruction (AFI) to inform and legitimize CHMPs as a potential course of action is one method to assist the AFSPC/SMC acquisition community to consider commercial hosting as an alternative to the traditional free-flyer approach. Having an AFI that explains CHMPs in detail would not only formally sanction the approach, but also raise awareness and provide details on how to execute a CHMP course of action. The AFI could list the challenges associated with implementing a CHMP and appoint offices of primary responsibility, like the Hosted Payload Office, to assist with these challenges. It could incorporate a lessons learned section from the commercial satellite industry on previous government hosted payloads (table 1). The AFI could also outline a streamlined contract approach to ensure future CHMP contract award opportunities do not rely solely on the successful award of the HoPs ID/IQ. This approach could mimic AFI 63-114, *Acquisition Quick Reaction Capability Process*, which gives roles, timelines, and responsibilities to key members in the CHMP acquisition process.[70]

However, the chief problem with simply issuing an instruction is getting the right people to read it, at the right time. Another challenge is getting AFSPC/SMC personnel to consider the information offered in

the instruction as a means to meet their satellite-based requirements. An AFI on CHMPs will not have value without supplying the proverbial "teeth," or means to force AFSPC/SMC acquisition personnel to consider a CHMP to meet their requirement.

To insert those teeth in the AFI, AFSPC/SMC leadership could request that Frank Kendall, the undersecretary of defense for acquisition, technology, and logistics (USD AT&L), issue an addendum to Directive-Type Memorandum (DTM) 09-025, Space Systems Acquisition Policy (SSAP). The addendum could dictate that program managers seeking approval of a material development decision for their satellite-based capability/program must demonstrate how CHMPs would be considered during the initial phases of program planning. If the program manager determined a CHMP is not a suitable solution, an explanation would be required prior to the USD AT&L allowing advancement to the next phase of the program. However, with this course of action, the USD AT&L must be extremely careful not to have the message of the addendum and CHMP AFI misinterpreted.

In my opinion, one way to disrupt future CHMP contract awards would be to force programs that do not align well with a commercial hosting methodology to pursue a CHMP solution. For example, if a program were forced into a CHMP solution despite obvious incompatibility because a program leader read a CHMP AFI and thought "that's what senior leaders want," the program would encounter schedule and cost growth issues. Mandating that program managers consider CHMPs could be viewed as the USD AT&L favoring a CHMP course of action. This concern should be addressed clearly in the proposed CHMP AFI and the USD AT&L's DTM 09-25 SSAP addendum. It should be stated that mandating a review of the feasibility of CHMPs by the USD AT&L is not to be interpreted as an attempt to drive all satellite-based capabilities to be solved by a CHMP solution. Rather, it is the goal to make AFSPC/SMC acquisition professionals aware of CHMP options and to consider them when appropriate.

A CHMP AFI, along with the addendum, would provide the impetus needed for AFSPC/SMC acquisition professionals to consider CHMPs as a means for meeting satellite-based requirements and potentially increase the number of CHMP contract awards. The CHMP AFI solution is the step which seems to be missing before a contract vehicle like the HoPs ID/IQ can truly be taken advantage of. The CHMP AFI would also improve upon the EWI concept by immediately legitimizing the CHMP solution from the top of the acquisition leadership structure. The EWI concept is more of an insurgent mind-set, where a few are given the

knowledge of the CHMP option and are expected to teach others and legitimize a shift in acquisition culture.

Conclusion

Senior leaders have articulated their desire to leverage CHMPs. The commercial satellite industry indicates that it would like to see the government utilize the available space on the industry's satellites to host military payloads. Yet only one CHMP has been awarded by SMC. There are numerous commercial satellites scheduled to launch over the next five years, but there are also numerous challenges which make implementing a CHMP solution difficult. The streamlined acquisition culture the commercial satellite industry operates in—firm-fixed-priced non developmental contracts are conceived and awarded, with the satellites in orbit in less than four years—is what attracts the government to CHMPs and makes them difficult to implement. AFSPC/SMC acquisition professionals are not accustomed to the commercial satellite industry's schedule-driven and informal (but thorough) oversight and review practices. AFSPC/SMC acquisition culture, born from the procurement of unique developmental free-flying satellite solutions, must be refocused to allow for the paradigm of CHMPs to be embraced.

AFSPC/SMC leadership has taken proactive measures to embrace the CHMP concept and established a Hosted Payload Office at SMC. At the time when this paper was written, SMC's Hosted Payload Office sought to streamline the CHMP contract award process by prequalifying a group of commercial satellite industry owner-operators and manufacturers to host military payloads under the HoPs ID/IQ contract vehicle. These two actions address many of the challenges that impede CHMP awards but by themselves do not address the cultural change required for CHMPs to be considered as an alternative in the first place.

Leveraging a 10-month EWI tour for space acquisition personnel in the commercial satellite industry followed by a mandatory four-year assignment at an AFSPC/SMC program office provides a long term method to refocus the acquisition culture. Unfortunately, this solution will take years to see any impact and leaves much of the culture change needed to increase CHMP contract awards up to chance. A CHMP AFI accompanied by an addendum to DTM 09-25 to ensure CHMPs are considered as an alternative to free flyers is one solution that could stand on its own. The HoPs ID/IQ option would be an excellent contract mechanism to accompany the AFI and addendum. However, the CHMP AFI, which leverages a USD AT&L addendum to DTM 09-25 SSAP to increase awareness and acceptance of CHMP solutions, could still increase the

number of CHMP contract awards in the near term if the HoPs ID/IQ is delayed or cancelled.

Notes

All notes appear in shortened form. For full details, see the appropriate entry in the bibliography.

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Abbreviations

ADF	Australian Defence Force
AFI	Air Force instruction
AFIT	Air Force Institute of Technology
AFSPC	Air Force Space Command
AT&L	acquisition, technology, and logistics
CCD	charge coupled device
CDR	critical design review
CHIRP	commercially hosted infrared payload
CHMP	commercially hosted military payload
DOD	Department of Defense
DTM	directive type memorandum
EGNOS	European GPS navigation overlay system
EWI	Education with Industry
FAA	Federal Aviation Administration
FFRDC	federally funded research development center
GAO	Government Accountability Office
GEO	geosynchronous Earth orbit
GPS	Global Positioning System
HoPs	hosted payloads
ID/IQ	indefinite delivery/indefinite quantity
IEEE	Institute of Electrical and Electronics Engineers
IRIS	Internet router in space
IRMA	in-orbit reconfigurable multibeam antenna
ISR	intelligence, surveillance, and reconnaissance
JAMI	Japan meteorological imager
LCRD	laser communications relay demonstration
LEO	low Earth orbit
MEO	medium Earth orbit
MILSATCOM	military satellite communications
NAIS	national automatic identification system
NASA	National Aeronautics and Space Administration
NTIA	National Telecommunications and Information Administration
OMB	Office of Management and Budget
PDR	preliminary design review
SAIC	Science Applications International Corporation
SBIRS	space-based infrared system
SMC	Space and Missile Systems Center
SSAP	Space Systems Acquisition Policy

SWaP	size, weight, and power
USD	undersecretary of defense
WAAS	wide area augmentation system

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